Amendments to the Claims:

This listing of claims replaces all prior versions and listings of claims in the application:

Listing of Claims:

1.   (Currently Amended) A computer-implemented method for providing convergence of ~~data~~ multiple copies of a table to a same state ~~in asynchronous data replication~~ in a database system, the database system including a plurality of nodes ~~with a plurality of table copies~~ each having a corresponding copy of the table, the method comprising:

    (a) ~~labeling rows of the plurality of table copies with a monotonic number, a copy identification, and propagation controls;~~ for each row of each table copy,

        associating a timestamp with the row, the timestamp indicating a time when a change to the row has occurred;

        associating a copy identification to the row, the copy identification being an identifier that uniquely identifies the table copy to which the row belongs; and

        associating propagation controls with the row, the propagation controls indicating whether a change to the row should be communicated to other table copies based at least in part on the timestamp of the change or the copy identification associated with the row;

    (b) asynchronously capturing ~~at least one labeled~~ a change to ~~any~~ a row of a given table copy ~~any of the plurality of table copies~~ from a database recovery log, the database recovery log containing an entry that describes the change to the row of the given table copy;

    (c) determining that the captured change to the row of the given table copy is to be communicated to ~~others of the plurality of~~ other table copies in the database system, the determination being made in accordance with the indication of the propagation controls associated with the changed row of the given table copy;

(d) communicating the captured change to the ~~others of the plurality of~~ other table copies in the database system; and

(e) applying the communicated change to the ~~others of the plurality of~~ other table copies in the database system, wherein ~~the plurality of table copies converge~~ each table copy in the database system converges to a same state.

2.   (Currently Amended) The method of claim 1, wherein the timestamp comprises a monotonic number ~~comprises~~ having a non-decreasing time value, wherein the time values for each ~~of the plurality of table copies are~~ table copy is in a common time base.

3.   (Currently Amended) The method of claim 2, wherein ~~the monotonic number is automatically applied to a changed table copy~~ associating a timestamp with the row includes associating the timestamp with the row in response to a user induced change of the row.

4.   (Currently Amended) The method of claim 1, ~~wherein the copy identification is assigned to each of the plurality of table copies, wherein the copy identification uniquely identifies each of the plurality of table copies,~~ wherein the copy ~~identifications for~~ identification uniquely identifying each ~~of the plurality of table copies have~~ table copy has an ordering property.

5.   (Currently Amended) The method of claim 4, wherein ~~the copy identification is automatically applied to a changed table copy~~ associating a copy identification to the row includes associating the copy identification to the row in response to a user induced change of the row.

6.   (Original) The method of claim 1, wherein the propagation controls comprise a delete label and a conflict label.

7.   (Currently Amended) The method of claim 6, wherein the delete label indicates that a row delete in ~~any of the plurality of table copies~~ a given table copy is not to be communicated to ~~the others of the plurality of~~ other table copies in the database system.

8.   (Currently Amended) The method of claim 6, wherein the conflict label indicates that an implicit row delete in ~~any of the plurality of table copies~~ a given table copy is to be communicated to ~~the others of the plurality of~~ other table copies in the database system, an implicit row delete being a deletion of a row due to a conflict.

9.   (Currently Amended) The method of claim ~~1~~ 6, wherein ~~the~~ asynchronously capturing ~~(b)~~ a change to a row of a given table copy comprises:

      ~~(b1)~~ accessing ~~at least one~~ the entry of the database recovery log pertaining to the ~~labeled~~ change of the row;

      ~~(b2)~~ determining a type of ~~the labeled~~ change to the row;

      ~~(b3)~~ extracting old column values and new column values of the ~~labeled change~~ row from the entry in the database recovery log ~~entry~~; and

      ~~(b4)~~ extracting changed key column values and unchanged key column values associated with the row from the entry in the database recovery log ~~entry~~.

10.   (Currently Amended) The method of claim 9, wherein the type of ~~the labeled~~ change to the row comprises a row insert, a row delete, a non-key update, or a key update.

11.   (Currently Amended) The method of claim ~~1~~ 10, wherein ~~the~~ determining ~~(e)~~ that the captured change to the row of the given table copy is to be communicated to other table copies in the database system comprises:

    ~~(e1)~~ examining ~~a labeled~~ the type of change ~~type~~ to the row of the given table copy, the copy identification associated with the row of the given table copy, and the propagation ~~control values for the captured change~~ controls associated with the row of the given table copy.~~, wherein the propagation control values comprises a delete label and a conflict label.~~

12.   (Currently Amended) The method of claim 11, wherein ~~the~~ determining ~~(e)~~ that the captured change to the row of the given table copy is to be communicated to other table copies in the database system further comprises:

    ~~(e2)~~ determining that the captured change to the row of the given table copy is to be communicated to ~~the others of the plurality of~~ other table copies in the database system ~~if~~ responsive to,

        the ~~labeled change~~ type of change to the row being ~~is~~ a row insert; and

        ~~if a~~ the copy identification ~~for the captured change~~ associated with the row ~~is a~~ being the same as a copy identification assigned to ~~a current~~ the given table copy.

13.   (Currently Amended) The method of claim 11, wherein ~~the~~ determining ~~(e)~~ that the captured change to the row of the given table copy is to be communicated to other table copies in the database system further comprises:

~~(c2)~~ determining that the captured change <u>to the row of the given table copy</u> is to be communicated to ~~the others of the plurality of~~ <u>other</u> table copies <u>in the database system</u> ~~if~~ <u>responsive to,</u>

the ~~labeled change~~ type <u>of change to the row being</u> ~~is~~ a row delete; and

~~if~~ the delete label ~~of the captured change~~ <u>associated with the row indicating</u> ~~indicates~~ that the captured change is to be communicated <u>to the other table copies in the database system.</u>

14.   (Currently Amended) The method of claim 11, wherein ~~the~~ determining ~~(c)~~ <u>that the captured change to the row of the given table copy is to be communicated to other table copies in the database system</u> further comprises:

~~(c2)~~ determining that the captured change <u>to the row of the given table copy</u> is to be communicated to ~~the others of the plurality of~~ <u>other</u> table copies ~~if~~ <u>responsive to,</u>

the ~~labeled change~~ type <u>of change to the row being</u> ~~is~~ a non-key update or a key update; ~~and~~

~~if~~ neither the delete label nor the conflict label ~~of the captured change~~ <u>associated with the row</u> indicates that the captured change is not to be communicated <u>to other table copies in the database system;</u> and

~~if~~ a new copy identification ~~of the captured change~~ <u>associated with the row being</u> ~~is a~~ <u>the same as the</u> copy identification assigned to ~~a current~~ <u>the given</u> table copy.

15.   (Currently Amended) The method of claim 1, wherein ~~the~~ communicating ~~(d)~~ <u>the captured change to the other table copies in the database system</u> comprises:

(d1) sending information ~~for~~ associated with the captured change to the ~~others of the plurality of~~ other table copies in the database system,

wherein ~~if~~ responsive to the ~~captured~~ type of change to the row being ~~is~~ a row insert, the information associated with the captured change comprises key column values, non-key column values, a ~~monotonic number~~ timestamp, and a copy identification ~~of the captured change~~ associated with the row of the given table copy.

16. (Currently Amended) The method of claim 1, wherein ~~the~~ communicating ~~(d)~~ the captured change to the other table copies in the database system comprises:

(d1) sending information ~~for~~ associated with the captured change to the ~~others of the plurality of~~ other table copies in the database system,

wherein ~~if~~ responsive to the ~~captured~~ type of change to the row being ~~is~~ a row delete, the information associated with the captured change comprises key column values, a ~~monotonic number~~ timestamp, and a copy identification ~~of the captured change~~ associated with the row of the given table copy.

17. (Currently Amended) The method of claim 1, wherein ~~the~~ communicating ~~(d)~~ the captured change to the other table copies in the database system comprises:

(d1) sending information ~~for~~ associated with the captured change to the ~~others of the plurality of~~ other table copies in the database system,

wherein ~~if~~ responsive to the ~~captured~~ type of change being ~~is~~ a non-key update, the information associated with the captured change comprises key column values, new non-key column values, an old ~~monotonic number~~ timestamp, a new ~~monotonic number~~ timestamp, an

old copy identification, and a new copy identification ~~of the captured change~~ <u>associated with the</u> <u>row of the given table copy</u>.

18. (Currently Amended) The method of claim 1, wherein ~~the~~ communicating ~~(d)~~ <u>the</u> <u>captured change to the other table copies in the database system</u> comprises:

~~(d1)~~ sending information ~~for~~ <u>associated with</u> the captured change to the ~~others of the~~ ~~plurality of~~ <u>other</u> table copies <u>in the database system</u>,

wherein ~~if~~ <u>responsive to</u> the ~~captured~~ <u>type of</u> change <u>being</u> ~~is~~ a key update, the information <u>associated with the captured change</u> comprises old key column values, new key column values, new non-key column values, an old ~~monotonic number~~ <u>timestamp</u>, a new ~~monotonic number~~ <u>timestamp</u>, an old copy identification, and a new copy identification ~~of the~~ ~~captured change~~ <u>associated with the row of the given table copy</u>.

19. (Currently Amended) The method of claim 1, wherein ~~the~~ applying ~~(e)~~ <u>the</u> <u>communicated change to the other table copies in the database system</u> comprises:

~~(e1)~~ detecting a conflict for the communicated change with ~~at least one~~ <u>a</u> row of a target table copy<u>, the target table copy being a table copy among the other table copy in the database</u> <u>system at which changes are to be replicated</u>;

~~(e2)~~ determining a priority for the communicated change ~~if~~ <u>responsive to</u> the conflict <u>being</u> ~~is~~ detected; and

~~(e3)~~ changing <u>the row of</u> the target table copy in accordance with the detected conflict and the determined priority for the communicated change.

20.   (Currently Amended) The method of claim 19, wherein ~~the~~ detecting ~~(e1)~~ <u>a conflict for</u> <u>the communicated change with a row of a target table copy</u> comprises:

~~(e1i)~~ ~~if~~ <u>responsive to the type of</u> the communicated change ~~is~~ <u>being</u> a row delete, the conflict is detected ~~if~~ <u>responsive to,</u>

no row of the target table copy with key column values matching key column values ~~of~~ <u>associated with</u> the communicated change is identified; or

for a row of the target table copy with key column values matching the key column values ~~of~~ <u>associated with</u> the communicated change,

a ~~monotonic number of~~ <u>timestamp associated with</u> the row of the target table copy does not match the ~~monotonic number of~~ <u>timestamp associated with</u> the communicated change; or

a copy identification of the row of the target table copy does not match a copy identification ~~of~~ <u>associated with</u> the communicated change.

21.   (Currently Amended) The method of claim 19, wherein ~~the~~ detecting ~~(e1)~~ <u>a conflict for</u> <u>the communicated change with a row of a target table copy</u> further comprises:

~~(e1i)~~ ~~if~~ <u>responsive to</u> the <u>type of the</u> communicated change ~~is~~ <u>being</u> a row insert, the conflict is detected ~~if~~ <u>responsive to,</u>

a row of the target table copy with key column values matching key column values ~~of~~ <u>associated with</u> the communicated change is identified.

22.   (Currently Amended) The method of claim 19, wherein ~~the~~ detecting ~~(e1)~~ <u>a conflict for</u> <u>the communicated change with a row of a target table copy</u> further comprises:

(e1i) if ~~responsive to~~ the ~~type of the~~ communicated change ~~is~~ being a non-key update, the conflict is detected ~~if~~ responsive to,

no ~~rows~~ row of the target table copy with key column values matching key column values ~~of~~ associated with the communicated change is identified; or

for a row of the target table copy with key column values matching the key column values ~~of~~ associated with the communicated change,

a ~~monotonic number of~~ timestamp associated with the row of the target table copy does not match ~~the~~ an old ~~monotonic number of~~ timestamp associated with the communicated change; or

a copy identification of the row of the target table copy does not match an old copy identification ~~of~~ associated with the communicated charge.

23. (Currently Amended) The method of claim 19, wherein ~~the~~ detecting ~~(e1)~~ a conflict for the communicated change with a row of a target table copy further comprises:

(e1i) if ~~responsive to~~ the ~~type of the~~ communicated change ~~is~~ being a key update, the conflict is detected ~~if~~ responsive to,

no row of the target table copy with key column values matching old key column values ~~of~~ associated with the communicated change is identified; or

for a row of the target table copy with key column values matching ~~the~~ old key column values ~~of~~ associated with the communicated change,

a ~~monotonic number of~~ timestamp associated with the row of the target table copy does not match an old ~~monotonic number of~~ timestamp associated with the communication change; or

a copy identification ~~of~~ associated with the row of the target table copy does not match an old copy identification ~~for~~ associated with the communicated change; or

a row of the target table copy with key column values matching new key column values ~~of~~ associated with the communicated change is identified.

24.   (Currently Amended) The method of claim 19, wherein ~~the determining (e2)~~ applying the communicated change to the other table copies in the database system comprises:

~~(e2i)~~ assigning priority to the communicated change ~~if~~ responsive to no conflict ~~is~~ being detected between the communicated change and the row of the target table copy.

25.   (Currently Amended) The method of claim 19, wherein ~~the~~ determining ~~(e2)~~ a priority for the communicated change comprises:

~~(e2i)~~ assigning priority to the communicated change ~~if~~ responsive to the type of the communication change ~~is~~ being a row insert; and

a ~~monotonic number of~~ timestamp associated with the communicated change is greater than a ~~monotonic number of~~ timestamp associated with the conflicting row in the target table copy; or

the ~~monotonic number of~~ timestamp associated with the communicated change is equal to the ~~monotonic number of~~ timestamp associated with the conflicting row, and a copy identification ~~of~~ associated with the communication change is greater than a copy identification ~~of~~ associated with the conflicting row.

26.   (Currently Amended) The method of claim 19, wherein ~~the~~ determining ~~(e2)~~ a priority for the communicated change comprises:

(e2i) assigning priority to the communicated change if responsive to the type of the communicated change is being a row delete and if responsive to,

no row in the target table copy matches key column values of associated with the communicated change; or

a monotonic number of timestamp associated with the communicated change is greater than a monotonic number of timestamp associated with the conflicting row in the target table copy; or

the monotonic number of timestamp associated with the communicated change is the same as the monotonic number of timestamp associated with the conflicting row and a copy identification of associated with the communication change is greater than a copy identification of associated with the conflicting row.

27.   (Currently Amended) The method of claim 19, wherein the determining (e2) a priority for the communicated change comprises:

(e2i) assigning priority to the communicated change if responsive to the type of the communicated change is being a non-key update and if responsive to,

no row in the target table copy matches key column values of associated with the communicated change; or

a monotonic number of timestamp associated with the communicated change is greater than a monotonic number of timestamp associated with the conflicting row in the target table copy; or

the monotonic number of timestamp associated with the communicated change is the same as the monotonic number of timestamp associated with the conflicting row and a copy

identification ~~of~~ associated with the communicated change is greater than a copy identification ~~of~~ associated with the conflicting row.

28.   (Currently Amended) The method of claim 19, wherein ~~the~~ determining ~~(e2)~~ a priority for the communicated change if the conflict is detected comprises:

~~(e2i)~~ assigning priority to the communicated change ~~if~~ responsive to the type of the communicated change ~~is~~ being a key update and ~~if~~ responsive to,

~~(e2iA)~~ no row in the target table copy matching old key column values ~~of~~ associated with the communicated change is identified; and

~~(e2iA(I))~~ no row in the target table copy matching new key column values ~~of~~ associated with the communicated change is identified; or

~~(e2iA(II))~~ a new ~~monotonic number of~~ timestamp associated with the communicated change is greater than a ~~monotonic number for~~ timestamp associated with the conflicting row in the target table copy with key column values matching new key column values ~~of~~ associated with the communicated change; or

~~(e2iA(III))~~ the new ~~monotonic number of~~ timestamp and copy identification associated with the communicated change matches the ~~monotonic number~~ timestamp and ~~a~~ copy identification ~~of~~ associated with the conflicting row in the target table copy with key column values matching new key column values ~~of~~ associated with the communicated change, respectively; or

~~(e2iB)~~ an old ~~monotonic number of~~ timestamp associated with the communicated change is greater than the ~~monotonic number of~~ timestamp associated with the conflicting

row in the target table copy with key columns matching old key column values ~~of~~ associated with the communicated change; or

the ~~monotonic number of~~ timestamp associated with the communicated change matches the ~~monotonic number of~~ timestamp associated with the conflicting row and an old copy identification ~~of~~ associated with the communicated change is greater than the copy identification ~~of~~ associated with the conflicting row with key column values matching old key column values ~~of~~ associated with the communicated change; and

~~(e2iB(I))~~ no row in the target table copy matching new key column values ~~in~~ associated with the communicated change is identified; or

~~(e2iB(II))~~ the new ~~monotonic number of~~ timestamp associated with the communicated change is greater than the ~~monotonic number of~~ timestamp associated with the conflicting row with key column values matching the new key column values ~~of~~ associated with the communicated change; or

~~(e2iB(III))~~ the ~~monotonic number of~~ timestamp associated with the communicated change matches the ~~monotonic number of~~ timestamp associated with the conflicting row and the new copy identification ~~of~~ associated with the communicated change is greater than the copy identification ~~of~~ associated with the conflicting row with key column values matching the new key column values ~~of~~ associated with the communicated change.

29.   (Currently Amended) The method of claim 19, wherein ~~the~~ changing ~~(e3)~~ the row of the target table copy comprises:

~~(e3i)~~ controlling propagation of the change applied to the target table copy;

(e3ii) insuring convergence of ~~the plurality of~~ each table ~~copies~~ copy in the database system to the same state; and

(e3iii) installing the communicated ~~changes~~ change into the target table copy.

30.   (Currently Amended) The method of claim 29, wherein ~~the~~ controlling ~~(e3i)~~ propagation of the change applied to the target table copy comprises:

(e3iA) ~~if~~ responsive to the type of the communicated change ~~is~~ being a row insert, setting a copy identification ~~of~~ associated with the applied change to the target table copy to a copy identification ~~received~~ associated with the communicated change.

31.   (Currently Amended) The method of claim 29, wherein ~~the~~ controlling ~~(e3i)~~ propagation of the change applied to the target table copy comprises:

(e3iA) ~~if~~ responsive to the type of the communicated change ~~is~~ being a row delete, updating a row of the target table copy with key column values matching key column values ~~of~~ associated with the communicated change by setting the delete label to indicate not to propagate the applied change.

32.   (Currently Amended) The method of claim 29, wherein ~~the~~ controlling ~~(e3i)~~ propagation of the change applied to the target table copy comprises:

(e3iA) ~~if~~ responsive to the communicated change ~~is~~ being a non-key or key update, setting a copy identification ~~of~~ associated with the applied change to the target table copy to the copy identification ~~received~~ associated with the communicated change.

33.   (Currently Amended) The method of claim 29, wherein ~~the~~ insuring ~~(e3ii)~~ <u>convergence</u> <u>of each table copy in the database system to the same state</u> comprises:

~~(e3iiA)~~ insuring propagation of an implicit delete change in the target table copy by setting a conflict label of the propagation controls ~~of~~ <u>associated with</u> the conflicting row when the <u>type of the</u> communicated change is a row insert, row delete, or non-key update assigned priority, and a copy identification ~~of~~ <u>associated with</u> the conflicting row is a copy identification assigned to the target table copy.

34.   (Currently Amended) The method of claim 29, wherein ~~the~~ insuring ~~(e3ii)~~ <u>convergence</u> <u>of each table copy in the database system to the same state</u> comprises:

~~(e3iiA)~~ insuring propagation of a delete change in the target table by setting a conflict label of the propagation controls ~~of~~ <u>associated with</u> the conflicting row with key column values matching old key column values ~~of~~ <u>associated with</u> the communicated change, when the <u>type of</u> <u>the</u> communicated change is a key update assigned priority, and a copy identification ~~of~~ <u>associated with</u> the conflicting row matches a copy identification assigned to the target table copy; and

~~(e3iiB)~~ insuring propagation of a delete change in the target table copy by setting a conflict label of the propagation controls ~~of~~ <u>associated with</u> the conflicting row with key column values matching new key column values ~~of~~ <u>associated with</u> the communicated change, when the <u>type of the</u> communicated change is a key update assigned priority, and a copy identification ~~of~~ <u>associated with</u> the conflicting row is a copy identification assigned to the target table copy.

35.   (Currently Amended) The method of claim 29, wherein ~~the~~ insuring ~~(e3ii)~~ <u>convergence</u> <u>of each table copy in the database system to the same state</u> comprises:

(e3iiA) recording communicated old key column values, an old ~~monotonic number~~ timestamp, and an old copy identification ~~of~~ associated with a conflicting change in the target table copy in a delete tombstone, when the type of the communicated change is a conflicting delete or a conflicting update with conflicting communicated old ~~monotonic number~~ timestamp or copy identification.

36.　(Currently Amended) The method of claim 29, wherein ~~the~~ insuring ~~(e3ii)~~ convergence of each table copy in the database system to the same state comprises:

　　　(e3iiA) checking for matching delete and suppressing application of the communication change ~~if~~ responsive to a delete tombstone matching the new key columns, new ~~monotonic number~~ timestamp, and new copy identification ~~of~~ associated with the communicated change ~~is being~~ found, when the type of the communicated change is an insert change or an update change with a conflicting insert assigned priority.

37.　(Currently Amended) The method of claim 1, further comprising:
　　　(f) reporting each conflicting change.

38.　(Currently Amended) The method of claim 37, wherein ~~the~~ reporting ~~(f)~~ each conflicting change comprises:

　　　(f1) reporting conflicting changes of a row delete, a row insert, or a non-key update change only when priority is not assigned to the communicated change and a copy identification ~~for~~ associated with a conflicting row in a target table copy is the copy identification assigned to the target table copy.

39.   (Currently Amended) The method of claim 37, wherein ~~the~~ reporting ~~(f)~~ <u>each conflicting change</u> comprises:

~~(f1)~~ reporting conflicting changes of a key update change only when priority is not assigned to the communicated change; and

a copy identification ~~for~~ <u>associated with</u> a conflicting row in a target table copy with key column values matching old key column values ~~for~~ <u>associated with</u> the communicated change is the copy identification assigned to the target table copy; or

a copy identification ~~for~~ <u>associated with</u> a conflicting row with key column values matching new key column values ~~for~~ <u>associated with</u> the communicated change is the copy identification assigned to the target table copy.

40.   (Currently Amended) A database system, comprising:

a plurality of nodes, ~~a plurality of table copies~~ <u>each node having a corresponding copy of a table</u>, wherein each row of ~~the plurality of~~ <u>each</u> table ~~copies are labeled with a monotonic number, a copy identification, and propagation controls~~ <u>copy includes:</u>

<u>a timestamp with the row indicating a time when a change to the row has occurred;</u>

<u>a copy identification, the copy identification being an identifier that uniquely identifies the table copy to which the row belongs; and</u>

<u>propagation controls indicating whether a change to the row should be communicated to other table copies based at least in part on the timestamp of the change or the copy identification associated with the row;</u>

a mechanism ~~for~~ <u>to</u> asynchronously ~~capturing~~ <u>capture</u> ~~at least one labeled~~ <u>a</u> change to ~~any~~ <u>a</u> row of ~~any of the plurality of table copies~~ <u>a given table copy in the database system</u> from a

database recovery log, the database recovery log containing an entry that describes the change to the row of the given table copy;

a ~~plurality of~~ message queue ~~queues~~ for communicating the captured ~~changes~~ change to ~~others of the plurality of~~ other table copies in the database system; and

a mechanism ~~for applying~~ to apply the communicated change ~~changes~~ to the ~~others of the plurality of~~ other table copies in the database system, wherein ~~the plurality of table copies converge~~ each table copy in the database system converges to a same state.

41.   (Currently Amended) The database system of claim 40, wherein the timestamp comprises a monotonic number ~~comprises~~ having a non-decreasing time value, wherein the time values for each ~~of the plurality of table copies are~~ table copy is in a common time base.

42.   (Currently Amended) The database system of claim 41, wherein the ~~monotonic number is automatically applied to a changed table copy~~ timestamp is associated with the row in response to a user induced change of the row.

43.   (Currently Amended) The database system of claim 40, wherein the copy identification ~~is~~ assigned to each ~~of the plurality of~~ table copy ~~copies, wherein the copy identification uniquely identified each of the plurality of table copies, wherein the copy identifications for each of the plurality of table copies have~~ has an ordering property.

44.   (Currently Amended) The database system of claim 40, wherein the copy identification ~~is automatically applied to a changed table copy~~ of a given row is associated with the row in response to a user induced change of the row.

45. (Currently Amended) The _database_ system of claim 40, wherein the propagation controls comprise a delete label and a conflict label.

46. (Currently Amended) The _database_ system of claim 45, wherein the delete label indicates that a row delete in any of the plurality of table copies is not to be communicated to ~~the others of the plurality of~~ _other_ table copies _in the database system_.

47. (Currently Amended) The _database_ system of claim 45, wherein the conflict label indicates that an implicit row delete ~~any of the plurality of table copies~~ _in a given table copy_ is to be communicated to ~~the others of the plurality of~~ _other_ table copies _in the database system, an implicit row delete being a deletion of a row due to a conflict_.

48-49. (Cancelled)

50. (Currently Amended) A computer readable medium with program instructions _tangibly stored thereon_ for providing convergence of ~~data~~ _multiple_ copies _of a table to a same state_ ~~in asynchronous data replication~~ in a database system, the database system including a plurality of nodes ~~with a plurality of table copies~~ _each having a corresponding copy of the table, the computer readable medium_ comprising ~~the~~ instructions for:

(a) ~~labeling rows of the plurality of table copies with a monotonic number, a copy identification, and propagation controls;~~ _for each row of each table copy,_

associating a timestamp with the row, the timestamp indicating a time when a change to the row has occurred;

associating a copy identification to the row, the copy identification being an

identifier that uniquely identifies the table copy to which the row belongs; and

associating propagation controls with the row, the propagation controls indicating whether a

change to the row should be communicated to other table copies based at least in part on the

timestamp of the change or the copy identification associated with the row;

(b) asynchronously capturing at least one labeled a change to any a row of a given table

copy any of the plurality of table copies from a database recovery log, the database recovery log

containing an entry that describes the change to the row of the given table copy;

(c) determining that the captured change to the row of the given table copy is to be

communicated to others of the plurality of other table copies in the database system, the

determination being made in accordance with the indication of the propagation controls

associated with the changed row of the given table copy;

(d) communicating the captured change to the others of the plurality of other table copies

in the database system; and

(e) applying the communicated change to the others of the plurality of other table copies

in the database system, wherein the plurality of table copies converge each table copy in the

database system converges to a same state.

51.   (Currently Amended) The computer readable medium of claim 50, wherein timestamp

comprises a monotonic number comprises having a non-decreasing time value, wherein the time

values for each of the plurality of table copies are table copy is in a common time base.

52.   (Currently Amended) The computer readable medium of claim 51, wherein the

monotonic number is automatically applied to a changed table copy instructions for associating a

timestamp with the row include instructions for associating the timestamp with the row in response to a user induced change of the row.

53. (Currently Amended) The computer readable medium of claim 50, ~~wherein the copy identification is assigned to each of the plurality of table copies, wherein the copy identification uniquely identifies each of the plurality of table copies,~~ wherein the copy ~~identifications for~~ identification uniquely identifying each ~~of the plurality of table copies have~~ table copy has an ordering property.

54. (Currently Amended) The computer readable medium of claim 53, wherein the ~~copy identification is automatically applied to a changed table copy~~ instructions for associating a copy identification to the row include instructions for associating the copy identification to the row in response to a user induced change of the row.

55. (Currently Amended) The computer readable medium of claim 50, wherein the propagation controls comprise a delete label and a conflict label.

56. (Currently Amended) The computer readable medium of claim 55, wherein the delete label indicates that a row delete in ~~any of the plurality of table copies~~ a given table copy is not to be communicated to ~~the others of the plurality of~~ other table copies in the database system.

57. (Currently Amended) The computer readable medium of claim 55, wherein the conflict label indicates that an implicit row delete in ~~any of the plurality of table copies~~ a given table

copy is to be communicated to ~~the others of the plurality of~~ other table copies in the database system, an implicit row delete being a deletion of a row due to a conflict.

58.   (Currently Amended) The computer readable medium of claim 50, wherein the instructions for asynchronously capturing ~~instruction (b) comprises~~ a change to a row of a given table copy include instructions for:

    (b1) accessing ~~at least one~~ the entry of the database recovery log pertaining to the ~~labeled~~ change of the row;

    (b2) determining a type of ~~the labeled~~ change to the row;

    (b3) extracting old column values and new column values of the ~~labeled change~~ row from the entry in the database recovery log ~~entry~~; and

    (b4) extracting changed key column values and unchanged key column values associated with the row from the entry in the database recovery log ~~entry~~.

59.   (Currently Amended) The computer readable medium of claim 58, wherein the type of ~~the labeled~~ change to the row comprises a row insert, a row delete, a non-key update, or a key update.

60.   (Currently Amended) The computer readable medium of claim ~~50~~ 59, wherein the instructions for determining ~~instruction (c) comprises~~ that the captured change to the row of the given table copy is to be communicated to other table copies in the database system include instructions for:

    (c1) examining ~~a labeled~~ the type of change ~~type~~ to the row of the given table copy, the copy identification associated with the row of the given table copy, and the propagation ~~control~~

values for the captured change ~~controls~~ associated with the row of the given table copy.~~, wherein~~

~~the propagation control values comprises a delete label and a conflict label.~~

61.   (Currently Amended) The <u>computer readable</u> medium of claim 60, wherein the
instructions for determining ~~instruction (e)~~ that the captured change to the row of the given table
copy is to be communicated to other table copies in the database system further ~~comprises~~
include instructions for:

    ~~(e2)~~ determining that the captured change <u>to the row of the given table copy</u> is to be
communicated to ~~the others of the plurality of~~ <u>other</u> table copies <u>in the database system</u>
<u>responsive to,</u>

        if the ~~labeled change~~ type <u>of change to the row being</u> ~~is~~ a row insert; and

        ~~if a~~ <u>the</u> copy identification ~~for the captured change~~ <u>associated with the row being</u>
~~is a~~ <u>the same as a</u> copy identification assigned to ~~a current~~ <u>the given</u> table copy.

62.   (Currently Amended) The <u>computer readable</u> medium of claim 60, wherein the
instructions for determining ~~instruction (e)~~ that the captured change to the row of the given table
copy is to be communicated to other table copies in the database system further ~~comprises~~
include instructions for:

    ~~(e2)~~ determining that the captured change <u>to the row of the given table copy</u> is to be
communicated to ~~the others of the plurality of~~ <u>other</u> table copies <u>in the database system</u> ~~if~~
<u>responsive to,</u>

        the ~~labeled change~~ type <u>of change to the row being</u> ~~is~~ a row delete; and

if the delete label ~~of the captured change~~ associated with the row indicating ~~indicates~~ that the captured change is to be communicated to the other table copies in the database system.

63.   (Currently Amended) The computer readable medium of claim 60, wherein the instructions for determining ~~instruction (c)~~ that the captured change to the row of the given table copy is to be communicated to other table copies in the database system further ~~comprises~~ include instructions for:

   ~~(c2)~~ determining that the captured change to the row of the given table copy is to be communicated to ~~the others of the plurality of~~ other table copies in the database system ~~if~~ responsive to,

      the ~~labeled change~~ type of change to the row being ~~is~~ a non-key update or a key update; and

      if neither the delete label nor the conflict label ~~of the captured change~~ associated with the row indicates that the captured change is not to be communicated to other table copies in the database system; and

      if a new copy identification ~~of the captured change~~ associated with the row is ~~a~~ the same as the copy identification assigned to ~~a current~~ the given table copy.

64.   (Currently Amended) The computer readable medium of claim 50, wherein the instructions for communicating ~~instruction (d) comprises~~ the captured change to the other table copies in the database system include instructions for:

   ~~(d1)~~ sending information for the captured change to the others of the plurality of table copies,

wherein ~~if~~ <u>responsive to</u> the captured change ~~is~~ <u>being</u> a row insert, the information comprises key column values, non-key column values, a monotonic number, and a copy identification of the captured change.

65.   (Currently Amended) The <u>computer readable</u> medium of claim 50, wherein the <u>instructions for</u> communicating ~~instruction (d) comprises~~ <u>the captured change to the other table copies in the database system include</u> instructions for:

    ~~(d1)~~ sending information for the captured change to the others of the plurality of table copies,

    wherein ~~if~~ <u>responsive to</u> the captured change ~~is~~ <u>being</u> a row delete, the information comprises key column values, a monotonic number, and a copy identification of the captured change.

66.   (Currently Amended) The <u>computer readable</u> medium of claim 50, wherein the <u>instructions for</u> communicating ~~instruction (d) comprises~~ <u>the captured change to the other table copies in the database system include</u> instructions for:

    ~~(d1)~~ sending information for the captured change to the others of the plurality of table copies,

    wherein ~~if~~ <u>responsive to</u> the captured change ~~is~~ <u>being</u> a non-key update, the information comprises key column values, new non-key column values, an old monotonic number, a new monotonic number, an old copy identification, and a new copy identification of the captured change.

67. (Currently Amended) The <u>computer readable</u> medium of claim 50, wherein the <u>instructions for</u> communicating <s>instruction (d) comprises</s> <u>the captured change to the other table</u> <u>copies in the database system include</u> instructions for:

(d1) sending information <s>for</s> <u>associated with</u> the captured change to <s>others of the</s> <s>plurality of</s> <u>other</u> table copies <u>in the database system,</u>

wherein <s>if</s> <u>responsive to</u> the <s>captured</s> <u>type of</u> change <u>to the row being</u> <s>is</s> a key update, the information <u>associated with the captured change</u> comprises old key column values, new key column values, new non-key column values, an old <s>monotonic number</s> <u>timestamp</u>, a new <s>monotonic number</s> <u>timestamp</u>, an old copy identification, and a new copy identification <s>of the</s> <s>captured change</s> <u>associated with the row of the given table copy</u>.

68. (Currently Amended) The <u>computer readable</u> medium of claim 50, wherein the <u>instructions for</u> applying <s>instruction (e) comprises</s> <u>the communicated change to the other table</u> <u>copies in the database system include</u> instructions for:

(e1) detecting a conflict for the communicated change with <s>at least one</s> <u>a</u> row of a target table copy<u>, the target table copy being a table copy among the other table copy in the database</u> <u>system at which changes are to be replicated</u>;

(e2) determining a priority for the communicated change <s>if</s> <u>responsive to</u> the conflict <s>is</s> <u>being</u> detected; and

(e3) changing <u>the row of</u> the target table copy in accordance with the detected conflict and the determined priority for the communicated change.

69.   (Currently Amended) The <u>computer readable</u> medium of claim 68, wherein the <u>instructions for</u> detecting ~~instruction (e1) comprises~~ <u>a conflict for the communicated change with a row of a target table copy include</u> instructions for:

    ~~(e1i)~~ if <u>responsive to the type of</u> the communicated change ~~is~~ <u>being</u> a row delete, the conflict is detected ~~if~~ <u>responsive to,</u>

    no row of the target table copy with key column values matching key column values ~~of~~ <u>associated with</u> the communicated change is identified; or

    for a row of the target table copy with key column values matching the key column values ~~of~~ <u>associated with</u> the communicated change,

        a ~~monotonic number of~~ <u>timestamp associated with</u> the row of the target table copy does not match the ~~monotonic number of~~ <u>timestamp associated with</u> the communicated change; or

        a copy identification of the row of the target table copy does not match a copy identification ~~of~~ <u>associated with</u> the communicated change.

70.   (Currently Amended) The <u>computer readable</u> medium of claim 68, wherein the <u>instructions for</u> detecting ~~instruction (e1) further comprises~~ <u>a conflict for the communicated change with a row of a target table copy further include</u> instructions for:

    ~~(e1i)~~ if <u>responsive to</u> the <u>type of the</u> communicated change ~~is~~ <u>being</u> a row insert, the conflict is detected ~~if~~ <u>responsive to</u> a row of the target table copy with key column values matching key column values ~~of~~ <u>associated with</u> the communicated change ~~is~~ <u>being</u> identified.

71.   (Currently Amended) The ~~computer readable~~ <u>computer readable</u> medium of claim 68, wherein the
<u>instructions for</u> detecting ~~instruction (e1) further comprises~~ <u>a conflict for the communicated</u>
<u>change with a row of a target table copy further include</u> instructions for:

~~(e1i)~~ <u>if</u> <u>responsive to</u> the <u>type of the</u> communicated change ~~is~~ <u>being</u> a non-key update,
the conflict is detected ~~if~~ <u>responsive to,</u>

no rows of the target table copy with key column values matching key column values ~~of~~
<u>associated with</u> the communicated change is identified; or

for a row of the target table copy with key column values matching the key column
values ~~of~~ <u>associated with</u> the communicated change,

a ~~monotonic number of~~ <u>timestamp associated with</u> the row of the target table copy
does not match ~~the~~ <u>an</u> old ~~monotonic number of~~ <u>timestamp associated with</u> the
communicated change; or

a copy identification of the row of the target table copy does not match an old
copy identification ~~of~~ <u>associated with</u> the communicated charge.

72.   (Currently Amended) The ~~computer readable~~ <u>computer readable</u> medium of claim 68, wherein the
<u>instructions for</u> detecting ~~instruction (e1) further comprises~~ <u>a conflict for the communicated</u>
<u>change with a row of a target table copy further include</u> instructions for:

~~(e1i)~~ <u>if</u> <u>responsive to</u> the <u>type of the</u> communicated change ~~is~~ <u>being</u> a key update, the
conflict is detected ~~if~~ <u>responsive to,</u>

no row of the target table copy with key column values matching old key column values
~~of~~ <u>associated with</u> the communicated change is identified; or

for a row of the target table copy with key column values matching ~~the~~ old key column
values ~~of~~ <u>associated with</u> the communicated change,

a ~~monotonic number of~~ <u>timestamp associated with</u> the row of the target table copy does not match an old ~~monotonic number of~~ <u>timestamp associated with</u> the communication change; or

a copy identification ~~of~~ <u>associated with</u> the row of the target table copy does not match an old copy identification ~~for~~ <u>associated with</u> the communicated change; or

a row of the target table copy with key column values matching new key column values ~~of~~ <u>associated with</u> the communicated change is identified.

73. (Currently Amended) The <u>computer readable</u> medium of claim 68, wherein the ~~determining instruction (e2) comprises~~ <u>instructions for applying the communicated change to the other table copies in the database system include</u> instructions for:

~~(e2i)~~ assigning priority to the communicated change ~~if~~ <u>responsive to</u> no conflict ~~is~~ <u>being</u> detected <u>between the communicated change and the row of the target table copy</u>.

74. (Currently Amended) The <u>computer readable</u> medium of claim 68, wherein the <u>instructions for</u> determining ~~instruction (e2) comprises~~ <u>a priority for the communicated change include</u> instructions for:

~~(e2i)~~ assigning priority to the communicated change ~~if~~ <u>responsive to</u> the <u>type of the</u> communication change ~~is~~ <u>being</u> a row insert; and

a ~~monotonic number of~~ <u>timestamp associated with</u> the communicated change is greater than a ~~monotonic number of~~ <u>timestamp associated with</u> the conflicting row in the target table copy; or

the ~~monotonic number of~~ timestamp <u>associated with</u> the communicated change is equal to the ~~monotonic number of~~ <u>timestamp associated with</u> the conflicting row; and

a copy identification ~~of~~ <u>associated with</u> the communication change is greater than a copy identification ~~of~~ <u>associated with</u> the conflicting row.

75. (Currently Amended) The <u>computer readable</u> medium of claim 68, wherein the <u>instructions for</u> determining ~~instruction (e2) comprises~~ <u>a priority for the communicated change</u> <u>include</u> instructions for:

~~(e2i)~~ assigning priority to the communicated change ~~if~~ <u>responsive to</u> the <u>type of the</u> communicated change ~~is~~ <u>being</u> a row delete and ~~if~~ <u>responsive to,</u>

no row in the target table copy matches key column values ~~of~~ <u>associated with</u> the communicated change; or

a monotonic ~~number of~~ <u>timestamp associated with</u> the communicated change is greater than a ~~monotonic number of~~ <u>timestamp associated with</u> the conflicting row in the target table copy; or

the ~~monotonic number for~~ <u>timestamp associated with</u> the communicated change is the same as the ~~monotonic number for~~ <u>timestamp associated with</u> the conflicting row and a copy identification ~~of~~ <u>associated with</u> the communication change is greater than a copy identification ~~of~~ <u>associated with</u> the conflicting row.

76. (Currently Amended) The <u>computer readable</u> medium of claim 68, wherein the <u>instructions for</u> determining ~~instruction (e2) comprises~~ <u>a priority for the communicated change</u> <u>include</u> instructions for:

~~(e2i)~~ assigning priority to the communicated change ~~if~~ <u>responsive to</u> the <u>type of the</u> communicated change ~~is~~ <u>being</u> a non-key update and ~~if~~ <u>responsive to,</u>

no row in the target table copy matches key column values ~~of~~ <u>associated with</u> the communicated change; or

a ~~monotonic number of~~ <u>timestamp associated with</u> the communicated change is greater than a ~~monotonic number of~~ <u>timestamp associated with</u> the conflicting row in the target table copy; or

the monotonic ~~number of~~ <u>timestamp associated with</u> the communicated change is the same as the ~~monotonic number of~~ <u>timestamp associated with</u> the conflicting row and a copy identification ~~of~~ <u>associated with</u> the communicated change is greater than a copy identification ~~of~~ <u>associated with</u> the conflicting row.

77.   (Currently Amended) The <u>computer readable</u> medium of claim 68, wherein the <u>instructions for</u> determining ~~instruction (e2) comprises~~ <u>a priority for the communicated change</u> <u>include</u> instructions for:

~~(e2i)~~ assigning priority to the communicated change ~~if~~ <u>responsive to</u> the <u>type of the</u> communicated change ~~is~~ <u>being</u> a key update and ~~if~~ <u>responsive to,</u>

~~(e2iA)~~ no row in the target table copy matching old key column values ~~of~~ <u>associated with</u> the communicated change is identified; and

~~(e2iA(I))~~ no row in the target table copy matching new key column values ~~of~~ <u>associated with</u> the communicated change is identified; or

~~(e2iA(II))~~ a new ~~monotonic number of~~ <u>timestamp associated with</u> the communicated change is greater than a ~~monotonic number for~~ <u>timestamp associated with</u> the conflicting row in the target table copy with key column values matching new key column values ~~of~~ <u>associated with</u> the communicated change; or

(e2iA(III)) the new ~~monotonic number~~ timestamp and a copy

identification ~~of~~ associated with the communicated change matches the

~~monotonic number~~ timestamp and ~~a~~ copy identification ~~of~~ associated with the

conflicting row in the target table copy with key column values matching new key

column values ~~of~~ associated with the communicated change, respectively; or

(e2iB) an old ~~monotonic number of~~ timestamp associated with the communicated

change is greater than the ~~monotonic number of~~ timestamp associated with the conflicting

row in the target table copy with key columns matching old key column values ~~of~~

associated with the communicated change; or

the ~~monotonic number of~~ timestamp associated with the communicated change

matches the ~~monotonic number of~~ timestamp associated with the conflicting row and an

old copy identification ~~of~~ associated with the communicated change is greater than the

copy identification ~~of~~ associated with the conflicting row with key column values

matching old key column values ~~of~~ associated with the communicated change; and

(e2iB(I)) no row in the target table copy matching new key column values

~~in~~ associated with the communicated change is identified; or

(e2iB(II)) the new ~~monotonic number of~~ timestamp associated with the

communicated change is greater than the ~~monotonic number of~~ timestamp

associated with the conflicting row with key column values matching the new key

column values ~~of~~ associated with the communicated change; or

(e2iB(III)) the ~~monotonic number of~~ timestamp associated with the

communicated change matches the ~~monotonic number of~~ timestamp associated

with the conflicting row and the new copy identification ~~of~~ associated with the

communicated change is greater than the copy identification ~~of~~ associated with

the conflicting row with key column values matching the new key column values
~~of~~ associated with the communicated change.

78.   (Currently Amended) The computer readable medium of claim 68, wherein the
instructions for changing ~~instruction (e3) comprises~~ the row of the target table copy include
instructions for:

(~~e3i~~) controlling propagation of the change applied to the target table copy;

(~~e3ii~~) insuring convergence of ~~the plurality of~~ each table ~~copies~~ copy in the database
system to the same state; and

(~~e3iii~~) installing the communicated ~~changes~~ change into the target table copy.

79.   (Currently Amended) The computer readable medium of claim 78, wherein the
instructions for controlling ~~instruction (e3i) comprises~~ propagation of the change applied to the
target table copy include instructions for:

(~~e3iA~~) ~~if~~ responsive to the type of the communicated change ~~is~~ being a row insert,
setting a copy identification ~~of~~ associated with the applied change to the target table copy to a
copy identification ~~received~~ associated with the communicated change.

80.   (Currently Amended) The computer readable medium of claim 78, wherein the
instructions for controlling ~~instruction (e3i) comprises~~ propagation of the change applied to the
target table copy include instructions for:

(~~e3iA~~) ~~if~~ responsive to the type of the communicated change ~~is~~ being a row delete,
updating a row of the target table copy with key column values matching key column values ~~of~~

<u>associated with</u> the communicated change by setting the delete label to indicate not to propagate the applied change.

81.   (Currently Amended) The <u>computer readable</u> medium of claim 78, wherein the controlling instruction (e3i) comprises instructions for:

(e3iA) ~~if~~ <u>responsive to</u> the <u>type of the</u> communicated change ~~is~~ <u>being</u> a non-key or key update, setting a copy identification of the applied change to the target table copy to the copy identification received with the communicated change.

82.   (Currently Amended) The <u>computer readable</u> medium of claim 78, wherein the <u>instructions for</u> insuring ~~instruction (e3ii) comprises~~ <u>convergence of each table copy in the</u> <u>database system to the same state include</u> instructions for:

(e3iiA) insuring propagation of an implicit delete change in the target table copy by setting a conflict label of the propagation controls ~~of~~ <u>associated with</u> the conflicting row when the <u>type of the</u> communicated change is a row insert, a row delete, or a non-key update assigned priority and a copy identification ~~of~~ <u>associated with</u> the conflicting row is a copy identification assigned to the target table copy.

83.   (Currently Amended) The <u>computer readable</u> medium of claim 78, wherein the <u>instructions for</u> insuring ~~instruction (e3ii) comprises~~ <u>convergence of each table copy in the</u> <u>database system to the same state include</u> instructions for:

(e3iiA) insuring propagation of a delete change in the target table by setting a conflict label of the propagation controls ~~of~~ <u>associated with</u> the conflicting row with key column values matching old key column values ~~of~~ <u>associated with</u> the communicated change, when the <u>type of</u>

the communicated change is a key update assigned priority and a copy identification of associated with the conflicting row matches a copy identification assigned to the target table copy.

84. (Currently Amended) The computer readable medium of claim 78, wherein the instructions for insuring instruction (e3ii) comprises convergence of each table copy in the database system to the same state include instructions for:

(e3iiA) recording communicated old key column values, an old monotonic number timestamp, and an old copy identification of associated with a conflicting change in the target table copy in a delete tombstone, when the type of the communicated change is a conflicting delete or a conflicting update with conflicting communicated old monotonic number timestamp or copy identification.

85. (Currently Amended) The computer readable medium of claim 78, wherein the instructions for insuring instruction (e3ii) comprises convergence of each table copy in the database system to the same state include instructions for:

(e3iiA) checking for matching delete and suppressing application of the communication change if responsive to a delete tombstone matching new key column values, new monotonic number timestamp, and new copy identification of associated with the communicated change is found, when the type of the communicated change is an insert change or an update change with a conflicting insert assigned priority.

86. (Currently Amended) The computer readable medium of claim 50, further comprising instructions for:

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(f) reporting each conflicting change.

87.   (Currently Amended) The <u>computer readable</u> medium of claim 86, wherein the <u>instructions for</u> reporting <s>instruction (f) comprises</s> <u>each conflicting change include</u> instructions for:

      (f1) reporting conflicting changes of a row delete, a row insert, or a non-key update change only when priority is not assigned to the communicated change and a copy identification <s>for</s> <u>associated with</u> a conflicting row in a target table copy is the copy identification assigned to the target table copy.

88.   (Currently Amended) The <u>computer readable</u> medium of claim 86, wherein the <u>instructions for</u> reporting <s>instruction (f) comprises</s> <u>each conflicting change include</u> instructions for:

      (f1) reporting conflicting changes of a key update change only when priority is not assigned to the communicated change; and

        a copy identification <s>for</s> <u>associated with</u> a conflicting row in a target table copy with key column values matching old key column values <s>for</s> <u>associated with</u> the communicated change is the copy identification assigned to the target table copy; or

        a copy identification <s>for</s> <u>associated with</u> a conflicting row with key column values matching new key column values <s>of</s> <u>associated with</u> the communicated change is the copy identification assigned to the target table copy.

89-90. (Cancelled)